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MENTAL AND PHYSICAL EFFECTS OF FRESH AIR

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BILL NYE'S History of the United States shows two drawings which compare the Indian women of fancy with the Indian women of fact. It is a pity that Nye did not think of cartooning the ventilation of fancy and the ventilation of fact. After the customary school instruction plus a deep draught of tradition we were caught unawares by a recent article in *THE SCIENTIFIC MONTHLY* asserting that human life could continue in the same room with oxygen-consuming plants. Perhaps some one will yet have the temerity to assert that the nostrils were made smaller than the mouth to prevent the breathing of all out-of-doors at one gasp, thus suffocating ourselves with too much fresh air. Is fresh air really essential? Are mental and physical prosperity greatest in 100 per cent. fresh air? Is it open air that human nature craves or is the primeval association of open air?

What is man's attitude toward the open air, as shown in the history of the race? Back somewhere in the time when man dwelt in the "well ventilated arboreal tenements" of the tree tops, some individuals, finding more to interest them on the ground, moved down from their leafy heights, and learned to walk upright. Beset, however, by countless enemies, he was compelled to seek some shelter, and so began the life in caves which has persisted ever since. Deserting the forests for more open country, man found his original covering of hair inadequate, and betook himself to clothing, the second step in the complete enclosure of his body.

Officially, man was a troglodyte, or cave dweller, up to a recent era in his history. As an actual, but unadmitted, fact, he is one yet. The ancient cliff-dwellers in their caves, and the more modern Moqui in his pueblo, are not so very different from the up-to-date apartment-house denizen, or shall we say, inmate. It does seem as though man for ages past had thriven in a completely enclosed state. Even in the matter of clothing to this day we go about protected to the utmost, the only exceptions being the rags of poverty and vice versa.

Ventilation has been for eons either unknown or unheeded. In

most cases entirely different considerations have fixed the construction of the buildings in which humans pass a great part of their time. In northern lands, for defense against cold, the Eskimos build their igloos, and the Lapps their huts, with one undersized door as the only opening. Many other examples are familiar. Ventilation as we know it, is truly a modern notion. In 1660, Sir Christopher Wren devised a crude system of ventilation for the Parliament Buildings in London, seemingly the first official recognition of the idea; but the spread of the idea has taken many years. In fact, those of us who have visited the halls of our own congress, will agree that those halls are to this day ventilated solely by the newspapers. The old four-poster bed, with its heavy canopy and impermeable curtains, is a commonplace of a day not far gone. It is but yesterday since we kept our windows shut at night, for fear of some poisonous "miasma" in the night air.

The modern preference for open windows, open-air schools and so on is due to one or the other of the following causes; either the desired sensation of being different from our fathers and mothers or the realization of some actual benefit to be derived from the new order of things. Let us see, then, what sort of opinions are actually held about the conditions which fix the desirability of the kind of air with which we surround ourselves.

Mr. Ellsworth Huntington, in a 1915 publication of the Yale University Press, says:

To-day a certain peculiar type of climate prevails wherever civilization is high. In the past, the same type seems to have prevailed wherever a great civilization arose. Therefore, such a climate seems to be a necessary condition of great progress.

The foregoing, part of an attempt to show the part played by climate in human development, is unfortunate, for a moment's thought will show that while each particular civilization may have its peculiar climate, these respective climates differed more widely than the civilizations they represented. Ancient Egypt, a country of great heat and dryness, is rated as a civilization, along with ancient Greece, with its temperate climate and adequate rainfall. A high civilization arose in Rome and along the warm, sunny slopes of Italy, but this fact proves nothing against the greatness of fog-visited Britain. In New York City, a more or less active hive of human effort, both extremes and all possible means of climate are experienced from one day to the next!

It is an acknowledged fact that warm air makes us sleepy. It is equally undisputed that we find it difficult to sleep on a warm night. When we suffer from certain ailments, our doctors, recommending a change of climate, send us to Colorado, Arizona, or

some place with an equally dry atmosphere. Yet we have authorities who regard dry air with dread. Watt, in 1910, wrote as follows:

Insanity grows on those who live in hot, dry air, do exasperating work, and feel abused. . . . Men are breaking down in business by too much attention to it, they think. The real trouble is, they are conducting their business in hot, dry rooms during the cold months of the year.

The same writer gives dryness as a cause of the falling-off in church attendance. It is to be hoped that the increased "dryness" to which the country is being subjected, will have the opposite effect. We are used to regarding dampness of air or climate as an unhealthful condition, but dryness seems to be just as bad, in the opinion of many. Early writers went to great extremes in both directions, attributing to air conditions all sorts of things, "from the color of a man's skin and the contour of his face, to the prevalence of religious ideas, and the (supposed) fact that more twins are born in Egypt than elsewhere," to quote from Stecher, in "The Effect of Humidity on General Efficiency."

Popular opinion is an excellent way to give permanence to prejudice. Bliss claims that so thoroughly has the fresh-air taken hold of many, that neither facts nor figures to the contrary are of the slightest interest. A remarkable example of this is found in the description of an experiment made in 1913-14 by D. C. Bliss, superintendent of schools of Montclair, N. J. He says:

A surprising feature of the whole experiment with the open-window classes is the attitude of the parents. Almost without exception they are convinced that their own children benefited greatly by the plan. This conviction is so positive that it is not affected in the least by the statistics of the classes.

These statistics, which showed a slight balance against the open-window classes, will be referred to later.

Many of us, then, believe that for health, atmospheric conditions should be thus and so. Clearly, however, a consideration of opinion from all sources shows about half of us in favor of "thus," and the rest of us firm believers in "so." In other words, public opinion, the strongest of forces in a discussion like this, is at the same time the least reliable. With the two camps of believers arranged back to back, it is at least possible that one is in the right, but opinion itself furnishes no safe ground for judgment. That opinion will often unconsciously pervert fact to serve its own ends was rather amusingly shown by press and other comments on an address recently made by the writer before the International Conference of Women Physicians. The newspaper writers took just enough actual words from the address to make some humorous reading which had no especial connection with the

speaker's meaning. A telegram was received from an association in a small city, asking for a statement of the speaker's true position. He replied that he was in favor of rightly controlled open-air schools *for experimental purposes*. The secretary of the association wrote back, much pleased with the speaker's "implied permission to quote you as favoring a rightly controlled open-air school." Using the same words, nearly, but with a vast difference in meaning, this little episode illustrates perfectly what might be called "auto-interpretation."

Since children are probably more sensitive to environmental conditions perhaps the best way to study the effects of fresh air *versus* various degrees of non-fresh air is to investigate experience and experiments with open-air, open-window, and otherwise fresh-air schools. The first open-air school was opened in the woods at Charlottenburg, a suburb of Berlin, and soon spread all over Germany. Not long afterward, the first English open-air school was opened at Bostall Wood, near London. Then came the Bradford School, since which many others have been established in England. The first open-air school in the United States was at Providence, R. I.; we now have them all over the United States. There are some in Boston; there is one on the roof of the Horace Mann School at Teachers' College, Columbia University; there are some on abandoned New York City ferry boats. There are specially endowed schools of this open-air type in Chicago. Hence comes the argument that the schools must be satisfactory, because they have spread so rapidly.

Secondly, we have no record of a single open-air school which has been abandoned; another argument worth noting.

Third, every account, except one, gives most glowing descriptions of the success of this work.

Fourth, children gain rapidly in weight. Here is a sample from one of the open-air schools. In two and one half months the children in this school gained 3.6 pounds on the average, whereas the children in the ordinary schools gained but one pound on the average.

The fifth proof is that the open-air schools have considerable therapeutic value. Here are some figures from some of the German schools. Of thirty-four children who were anemic, after being in the open-air schools for some time, one case was aggravated, nine were unchanged, eleven were improved and thirteen cured. Of 38 cases of scrofula, none was aggravated, eight were unchanged, 22 were improved and eight cured. Of 14 cases of heart-disease, none was aggravated, seven unchanged, seven improved and none cured. Of 21 cases of pulmonary disease, one was aggravated,

eight were unchanged, eight were improved, and four were cured. This makes a total of 107 children that were studied; of which number but two were aggravated, 32 were unchanged, 38 improved and 25 cured.

Next, there comes the claim from England and Germany that education is twice as efficient, in the sense that the pupils spend but half their time on regular school work, and still keep up with their corresponding grades in the ordinary schools.

A number of other claims are made, such as increased happiness of the children; improvement in attendance; and one statement is made that truthfulness rose several degrees!

A critical inspection of these claims reveals that they are largely claims and nothing more. They may be true, they may not be true. Open-air schools are such a radical departure that their very novelty appeals to radicals and enthusiasts. This alone might account for the rapid spread of the idea.

The claim that education in open-air schools is twice as efficient does not appear to have been checked by objective tests. Subjective estimates of mental changes are known to be extremely unreliable, particularly when made by interested though honest individuals.

The increase in attendance recorded for the open-air schools, it must be said, took place entirely during those months of the year when the weather is at its best. This is typical of most of the arguments advanced; they are not checked against certain other possible explanations of the results besides the presence of fresh air.

Here is a typical day for the pupils in the ordinary school, which may be compared with the typical day of the open-air school scholars. In the ordinary school, the pupils spend all their time during the best part of the day, that is, from nine to twelve o'clock and from one o'clock to three, in the classroom. The medical, dental and optical care they receive from the school authorities is inadequate to put it as charitably as possible, and they receive little other attention aside from their regular lessons. Here is the program of the open-air school for a day. Reports state that the enthusiastic cooperation of the best dentists, physicians and oculists in town is readily secured, so that the children are constantly receiving better attention than they would in their own homes. At eight a. m., an hour before the ordinary schools begin, the open-air pupils are served with hot soup, bread and butter. After every half-hour, they have vigorous exercise. At ten a. m. they have two glasses of milk, bread and butter. At 12:30 they have a good dinner, followed by sleep. At 4 p. m. there is milk, rye bread and jam. At 7 p. m.—notice how late—the pupils are given a good supper, and sent home. Of course, the regular les-

sons are given in the intervals between the items noted above. The program outlined is actually followed in many schools, and all adhere to a similar schedule in greater or less degree.

We find in one of the glowing descriptions of these schools the following unintentional admission—quoted exactly:

“There is unanimous agreement that if children are to be benefited by open air, they must be well-fed.” This statement is typical of the weak points in the arguments thus far given: Is it fresh air that produces the results, or is it superior feeding and physical care; and would it be possible to produce the same effect in the ordinary schools, by an equally increased care? The arguments do not tell us.

What light do carefully-controlled researches throw upon this whole question? Experimental results tend to show that mental activity, obviously one of the main factors in education, is not readily subject to outside influences. Poffenberger, administering strychnine in moderate doses, noted that no effect was produced on the mental powers of his subjects. Hollingworth reached the same conclusion with regard to caffeine in the proportions found in coffee and certain other beverages. Results are not yet available from the national experiment conducted to discover the effect of reducing the national percentage of alcohol to 2.75. On the whole, mentality appears to be a peculiarly well insulated function. The writer after years as a teacher, has found the insulation impenetrable in many cases.

But there are experiments dealing with open-air directly. A study was made by Norsworthy, Hillegas, McCall and others at the Horace Mann School, New York City. On the roof of the building were constructed two classrooms, each having its southern side completely open, and large windows in its other sides and roof. Provision was made to shield books and blackboard from the direct glare of the sun, but otherwise the children were exposed to sunshine and air. The southern exposure could be closed off by a canvas cover during a driving rain. A playground was provided on the adjoining roof.

The open-air test was begun with a third grade and a fourth grade class. After the first year a fifth grade class was held in a room in the building below, this room having its windows open wide at all times. There were throughout the test several control classes in ordinary indoor classrooms, for purposes of comparison. The test continued through the four school years from 1912 to 1916. Psychological tests were made in each December and May by Norsworthy and Hillegas. At the same time, Dr. H. B. Keyes gave each child a thorough physical examination. There were

eight of the psychological tests given each time. The scores of these tests were summarized into a combined score for the four years. This result showed a small, but real, balance in favor of the open-air classes. This was also true for the physical tests for the first year, those for the other three years not being available. We must accept these results, however, with proper caution, because of the possibility that other factors than those tested were responsible for the result. The children who made up the open-air group were selected from those having physical or nervous weaknesses or tendencies. There were extra lunches and frequent outdoor play; these were denied the indoor classes, which might have had them about as well as the outdoor pupils. In any case, we must be careful about comparing the performances of more or less incomparable groups.

Consider now the experiment conducted by D. C. Bliss, superintendent of schools of Montclair, N. J., to determine the possible advantage of open-window classes. In this experiment, the same types of children were selected for both open-window and control classes. One class each from the second, third and fifth grades, were selected for the open-window group, each grade being located in a different building, and each checked by a control class of the same grade and size in the same building but under indoor conditions. During the cold months, the open-window groups were well wrapped, and protected against strong drafts, though their classrooms were maintained at a temperature of 50 degrees Fahrenheit. During the experiment, the open-window pupils were provided with light forenoon lunches at the parents' expense.

The tests measured three items: degree of nutrition, measured by fluctuations in weight; general health, indicated by attendance; and mental condition, shown by simple tests given twice each day.

A summary of Bliss's results shows no difference between the open-window and control groups in the psychological tests, and a small, but notable superiority in health for the control groups. In the previous year, an experiment had been made in which the open-window class was unprovided with the special lunch, and the room-temperature allowed to go as low as it would. Under these conditions, the health of the open-window classes showed up even less favorably.

Whatever our previous idea, then, the contradictory results of the two experiments cited should give us pause. More information is evidently needed. To this end, we ought to note the interesting and expertly directed experiment made by the New York State Commission on Ventilation, to determine the effect on mental

work, of recirculated air versus plenty of fresh air. The Board of Education of New York City permitted the commission to fit up especially for the test a couple of rooms in a school building that was in the course of erection. Hence the desired air conditions could be perfectly maintained. In one room, ventilating ducts provided a continuous influx of fresh air, the used air being drawn out. In the other room, the used air was drawn out, washed, and sent back again, so that the greater part of the air in the second room was used over and over. Only enough fresh air was introduced to prevent noticeable odor. The washing took out the dust, and probably the germs and some, at least, of the carbon-dioxide. Even so the C O_2 content of the air in the recirculating room was always much higher than in the fresh-air room, occasionally rising to twice as much. In both rooms, the purity of the air and the steam used by the heating-plant were constantly noted. A standard comfortable temperature of 68° and humidity of 50 per cent. were maintained in both the experimental and control rooms.

The experiment lasted from February to June of one year, and to make conclusions doubly reliable was repeated during the following school year. An unusually elaborate series of educational, psychological and physical measurements were made. The directors of these experiments were national authorities in their respective fields of education, psychology, medicine, physiology, sanitation, physics and engineering. No technique that these scientists could devise was omitted. Every effort was made to make the conclusion from these experiments final. What was the conclusion? The results from all the educational and psychological measurements when carefully summarized, showed roughly two per cent. greater progress and achievement for the pupils who were in the partly fresh air. The results from the medical measurements substantially agreed with those from the mental measurements, and the second experiment agreed with the first.

In addition to having no demonstrable deleterious mental or physical effects, the recirculation plan required only half the coal for heating that was needed for the fresh-air room. This enormous saving, widely applied, would buy for children many things of known mental and physical worth.

Glancing back over the propaganda for and against open-air schools we are tempted to paraphrase Pinckney: "Millions for defense but not one cent for" *the truth*. There has never been a really valid experiment to show whether open-air schools are desirable or undesirable. It is undoubtedly true that anemic pupils in open-air schools have more rapidly improved in weight,

health, hemoglobin and the like, but the thinnest readers of this article have a good chance of growing fat and hemogloby on the sanitary and feeding schedule of the best open-air schools! Personally we are inclined to favor open-air schools, not for the surplus of fresh air but because that seems to be the only way to secure for a few pupils a scientific attention which should be the privilege of all pupils. But such a policy is altogether too much like the Chinaman who burned his house to roast his pig.

Not even the admirable experiments of the New York State Commission on Ventilation tell us whether open-air schools are or are not advisable. Open-air schools usually bring sunshine to their pupils as well as fresh air. Furthermore the Ventilation Commission's experiments used typical pupils as subjects. Though it does not appear probable, it may be that anemic and diseased pupils prosper better on fresh air than normal pupils. But as matters now stand undiluted fresh air for children is on the defensive. The only trustworthy experiments to date have gone against absolute fresh air. Verily we are by nature Cave Dwellers still!